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ABSTRACT

The early development of wariness toward unfamiliar persons and novel objects is examined. Data are based upon the reactions of 32 infants who were repeatedly observed, over the age period 3 to 9 months, as they responded to the near approach of a stranger, and to a variety of new objects. Signs of wariness toward unfamiliar persons began to appear during the fourth month of life, and became increasingly frequent in the second half of the first year. In the second six months of life, the conditions of an encounter strongly affected the incidence of wariness provoked by the stranger (e.g., whether the infant was in mother's arms, or was picked up by the stranger), and by these ages various aspects of an infant's interpersonal history had begun to determine the quality of his response. At all ages the novel objects promoted mainly exploratory interest, and only at 9 months did some minimal signs of wariness appear. Detailed consideration has been given to the parameters affecting reactions to the unfamiliar, including the temperament of the infant, the qualities of the unfamiliar stimulus, the nature of the encounter situation, and the age and experiential history of the infant. It is tentatively concluded that toward the latter part of the first year infants may be entering a period in which the quality of their environment is important in determining their future social orientation. (DB)

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EARLY DETERMINANTS OF REACTIONS TO THE UNFAMILIAR

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SUMMARY

The study examines the early development of wariness toward unfamiliar persons and novel objects. Data are based upon the reactions of 32 infants who were repeatedly observed, over the age period 3 to 9 months, as they responded to the near approach of a stranger, and to a variety of new objects. Signs of wariness toward unfamiliar persons began to appear during the fourth month of life, and became increasingly frequent in the second half of the first year. Infants who were particularly prone to distress in the first few months of life were the first to show signs of wariness, and in general they remained more wary than other babies as they grew older. In the second 6 months of life the conditions of an encounter strongly affected the incidence of wariness provoked by the stranger (e.g., whether the infant was in mother's arms, or was picked up by the stranger), and by these ages various aspects of an infant's interpersonal history had begun to determine the quality of his response. At all ages the novel objects promoted mainly exploratory interest, and only at 9 months did some minimal signs of wariness appear; it is not certain whether these reactions were transitory, or were evidence of a beginning wariness toward novelty found in the non-human environment. Detailed consideration has been given to the parameters affecting reactions to the unfamiliar, including the temperament of the infant, the qualities of the unfamiliar stimulus, the nature of the encounter situation, and the age and experiential history of the infant. It is tentatively concluded that toward the latter part of the first year infants may be entering a period in which the quality of their environment is of particular importance in determining their future social orientation.

INTRODUCTION

It is well established that infants are sometimes upset by the near approach of a stranger (see Bronson, 1968a, and more recently Bronson, 1969a and b, and Scarr and Salapatek, 1970)--but it remains uncertain as to exactly when such reactions first appear, what factors may increase their occurrence, and whether some infants are particularly prone to be wary. Whether comparable reactions are easily elicited by novel objects is not known. The studies in this domain are few and contradictory (i.e., Lang, 1966; Pulver, 1959; Scarr and Salapatek, 1970; and Schaffer, Greenwood and Parry, in press); it is not clear whether the paucity of research is due to the rarity of the reaction or whether a focus on other issues has led experimenters to dismiss instances in which infants were upset by novel objects. In brief, to explore the ontogeny of aversive reactions to unfamiliar stimuli both normative and longitudinal data are needed on infants' reactions both to strange persons and to novel objects. Such considerations dictated the strategy of the present research.

Attention was focused on developments from age 3 to 9 months because it is presumably within this period that infants first clearly distinguish between familiar and unfamiliar configurations. Experimental procedures approximated naturally occurring situations: observations were conducted in the subjects' homes, and encounters with a stranger were of a kind that might frequently be experienced in an infant's normal routine; novel objects and a strange person were presented in similar contexts to permit a rough comparison of responses given to different categories of unfamiliar stimuli. Subjects' reactions were recorded on videotape, thereby avoiding the limitations inherent in an a priori selection of response categories. Infants were tested repeatedly at each age (as well as across ages) to determine the degree to which observed behavioral differences were stable attributes of the individual infants. And, in addition to observing reactions to the unfamiliar, various other assessments of the infant and of his home environment were included to seek the determinants of divergent developmental patterns.

It is the intent of this report to go beyond the presentation of research findings, and to give structure, within the framework provided by an ethological perspective, to this relatively unexplored area of infant development. Toward this end, interpretations are at times extended into areas that are but dimly illuminated by the available data. Since the issues are many and the data extensive, results and discussions are combined within sections that focus on particular facets of the larger problem.

METHOD

Subjects

The sample consisted of 32 infants, 16 males and 16 females; roughly half were first-born. Half of the babies had parents of Caucasian ancestry, while among the remaining either one or both parents were Japanese, Chinese, Philippino, Hawaiian, or a combination of these ancestries (although not ethnically accurate, the latter babies will be referred to as Oriental). The numbers of infants in each cell of the three-dimensional matrix defined by the subject variables (sex, birth order, and ancestry) were roughly equal; exact numbers can be derived from Figure 5. The two criteria for inclusion in the study were evidence of normal development to the terminal age of 9 months and the mother's willingness to participate in the program. The infants' parents were mainly of middle class background, most of whom lived in small apartments in the Honolulu area of Hawaii. All families included an adult male who joined in caring for the infant.

Experimental Procedures

Observations were made in the infants' homes by the male "stranger" and a female assistant as the subjects reached 3, 4, 6-1/2 and 9 months of age (the infants were within a few days of being 14 and 17 weeks old, respectively, at the 3- and 4-month visits). Two assessments using identical procedures and spaced several days apart were made at each of the four ages.

The core data consist of video records of infants' reactions to encounters with a strange adult and with a variety of unfamiliar objects (1).[1] The stranger encounters were conducted in a manner designed to elicit any potential wariness, and yet remain representative of experiences that an infant might meet in the normal course of events. The novel objects were chosen with the same intent, but in the absence of studies identifying the possible stress inducing aspects of non-human stimuli their selection was largely intuitive; salience was assured by the use of bright colors, plus either gentle motion or the emission of a moderate sound. Additionally, at each age infants were exposed to a looming stimulus (the opening of a small parasol) to assess reactions to the occurrence of a sudden event. Tests were conducted prior to the study to determine stimulus sequences that were unlikely to produce serious order effects; analyses of the data indicate that with one exception such effects were indeed minimal. At every age an initial "Episode A" preceded the formal testing to assure that testing conditions were comfortable for the infants; procedures followed when this proved not to be the case are discussed in the section on missing data.

The following outline describes the video-recorded procedures used at each age; except where noted the stranger and his assistant remained out of the baby's sight.

Ages 3 and 4 months. The camera looked down on the baby's crib from a tripod set about 1-1/2 meters away; a rod extended horizontally from the tripod to allow novel objects to be hung over the infant's crib (this equipment was consistently ignored). The experimental sequence consisted of two identical stranger encounters separated by the presentation of a series of novel objects.

Episode A. Mother placed the infant in the crib and remained speaking to her baby for about 15 seconds.

Episode 1: Stranger I. The stranger--a middle-aged Caucasian male, beardless--bent over to about 1/2 meter from baby, smiled

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1. Additional information will be found in the Notes section.

slightly and spoke, repeatedly calling baby's name and asking for a smile. His face was at an angle of about 45° from the midline axis of the infant's face. The episode lasted for about one minute unless the infant gave a series of almost contiguous broad smiles or began to cry before the time expired, in which case the stranger withdrew (2).

Episode 2. Mobile. For 1/2 minute infants were presented with a slowly revolving mobile consisting of a pair of golden balls 8 cm. in diameter (cotton-wound Christmas ornaments) mounted at the ends of a 20 cm. rod. A thread attached at the middle of the rod suspended it in a horizontal position.

Episode 3. Bracelets. A set of 5 plastic bracelets suspended on a thread, each half overlapping with the one above, was dangled for 1/2 minute just above the infant's chest.

Episode 4. Wand. One of the 8 cm. golden balls attached to a 1 meter shaft was repeatedly swung in an arc from about 1/2 meter above the infant down to about 5 cm. from his nose. The movement was slow and rhythmical, each cycle lasting about 5 seconds.

Episode 5. Parasol. A red-patterned paper parasol 35 cm. in diameter was held with its white tip about 15 cm. from the infant's face and rapidly opened (i.e., in about 1/2 second) and closed 3 times.

Episode 6. Stranger II. Repeat of the Stranger I episode.

Age 6-1/2 months. Baby sat upright in a modified infant seat on the floor of a familiar room; a low screen attached behind the seat hid the experimenter as he presented various objects before the infant. Mother seated her infant, then sat within his view about 1-1/2 meters to one side. The video camera ran unattended on the floor about 2 meters away (it was consistently ignored by the infants). The main departure from the previous experimental sequence --the presentation of a novel object before the first of the two stranger encounters--was introduced in the anticipation that infants might now be upset by the stranger, thereby preventing the unambiguous interpretation of responses in following object episodes. Also, a final episode was added in which the stranger picked up the infant.

Episode A. A bamboo windchime was extended before the baby to determine whether he was sufficiently content to attend to experimental stimuli.

Episode 1. Novel Object I. Pushed by a plastic rod, a rather large boxlike object was slid around from one side of the screen to within reach of the infant. It was 45 cm. tall, 25 cm. wide and 20 cm. deep, and covered with ruffled crepe

paper, red at the bottom and red and white in the upper portion. Inside was a battery-powered relaxation oscillator connected to a 3-inch speaker which emitted a random series of short and long beeps (an average of about 1 beep per second at 410 Hz and of moderate intensity). The object remained for about 1/2 minute.

Episode 2. Stranger I. The stranger walked slowly around the screen and into baby's view, then squatted about 1/2 meter away and smiled and began to speak to the infant. As at previous ages he remained for 1 minute unless the baby responded with repeated broad smiles or began to cry before the period elapsed.

Episode 3. Novel Object II. Repeat of the Object I episode.

Episode 4. Wand. Repeat of the 3- and 4-month wand episode.

Episode 5. Stranger II. Repeat of the Stranger I episode. If the baby did not cry during the episode, mother said good-bye and left the room for about 1/2 minute.

Episode 6. Parasol. Repeat of the 3- and 4-month procedure (except that now the stranger was in view as he presented the stimulus).

Episode 7. Pick-up. Unless crying was induced by the mere presence of the stranger, he gently picked baby up and sat him face-to-face on his knee for about 1 minute, or until the baby began to cry or to repeatedly smile (3).

Age 9 months. Mother sat baby on the floor within reach of a small cloth dog, then seated herself within baby's view about 1-1/2 meters to one side. The camera ran unattended on the floor some 2 meters away (with a few exceptions it was ignored). The previously described Novel Object was on the floor about 45 cm. from the seated infant, but covered by a loose brown cloth. As at the preceding age, the experimental sequence begins with presentation of the Novel Object.

Episode A. The infant was allowed about 10 seconds of examination of the toy dog to determine his comfort with the testing situation.

Episode 1. Novel Object I. The assistant approached quietly from the far side of the object, removed the covering cloth, switched on the beeping mechanism, and then immediately left the room. The episode lasted for 1 minute, or until the infant cried, crawled to mother, or approached the object and became engaged in manual exploration.

Episode 2. Stranger I. The stranger entered the room and recovered and drew back the novel object as he squatted about one-

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half meter from the baby, smiling slightly and speaking. He remained for about 1 minute, unless the infant repeatedly smiled or crawled to mother or began to cry.

Episode 3. Novel Object II. The stranger pulled the object to within about 45 cm. from the baby, uncovered it, turned on the sound and left the room; the episode then continued as in Episode 1.

Episode 4. Stranger II. Repeat of the Stranger I episode.

Episode 5. Parasol. Repeat of the 6-1/2-month procedure.

Episode 6. Pick-up. Repeat of the 6-1/2-month procedure. If the baby did not cry during the episode mother then said good-bye and left the room for about 1/2 minute.

Coding of Video Records

A set of coding categories adequate for describing the range of infant reactions was derived from preliminary reviews of the video records. Most measures focused on specific facets of behavior --e.g., patterns of staring and gaze aversion, response latencies, etc; since the resulting scales will require only brief description they will be presented when the corresponding data are to be analyzed. An exception is the Affect Scale, a measure that described by a single rating the overall quality of response to either an object or to the stranger at any age. The behavioral criteria defining each scale point are given in Table 1; they focused on the infants' facial expression, vocalization, and gross body movement.

Table 1
Criteria for the Affect Scale Ratings of Dominant Emotional Tone

Scale Point	Category Description	Criterion Behaviors for Each Age		
		3 & 4 months	6-1/2 months	9 months
1	Smiled with delight	Wiggled or vocalized as smiled	Repeated broad smiles, or smiles with pleasure vocalizations	
2	Smiled	Smiled more than once, but not broadly		
3	Neutral	Predominantly blank expression and no vocalization		
4	Uneasy	Severe frown or puckering of chin	Frowned, or vocalized unhappily (or, on Pick-up, turned body away)	Frowned, vocalized unhappily, or crawled to mother (or, on Pick-up, squirmed or turned body away)
5	Cried	Cried or whimpered		

This single scale confounds what, in principle, could be regarded as two independent dimensions--the proclivity to smile and the tendency to be wary; for example, it is conceivable that within a given episode an infant might both smile and show clear signs of wariness, a pattern not well described by a mid-scale rating. In practice, however, such mixed reactions rarely occurred. In these few instances ratings reflected the evidence of wariness, and the occurrence of a mixed reaction was noted by marking one of the following Checklist items:

Item a: Changing reaction. Following a protracted inspection of the stranger's face the infant's response changed from an unqualified smile to clear signs of uneasiness (i.e., frowning or crying), or vice versa.

Item b: Ambivalent reaction. The infant almost concurrently both smiled and showed evidence of uneasiness (i.e., frowned, crawled to mother, or insistently turned away).

Naive raters worked in pairs in coding the video records. Their independent judgments were reviewed only in instances of marked disagreement; upon review a rater was allowed to change if he wished--the incidence of ratings thus altered was less than 6%.

Interview and Home Assessment Data

The initial three-month visits lasted for nearly an hour, and included an interview plus observations of routine caretaking, including bathing of the infants. These extended observations formed the basis for rating the quality of maternal care and the degree to which an infant was prone to recurrent crying. The scales that were used, plus the nature of the interview materials collected, will be introduced when the relevant issues are analyzed.

From the 4-month assessments onward infants' reactions were observed to the approach of the female assistant when the babies were held in mothers' arms. These tests were conducted shortly after entering, and some minutes before beginning the experimental sequences.(4).

Missing Data

One family withdrew after the 4-month observations, and two moved away following the 6-1/2-month assessments. Two percent of the episodes are missing because of technical difficulties--e.g., equipment failure, interference by siblings, etc. None of these factors could have introduced a selective bias into the remaining data. Instances of persistent crying, however, raised more difficult issues. On a number of occasions 3- or 4-month-old infants cried whenever put down by the mother; to prevent bias due to a selective under-representation of data on difficult infants, repeat

visits were arranged as necessary. When an infant began to cry within the sequence of episodes, however, testing was abandoned if the baby could not easily be quieted, and no repeat visits were attempted. Some additional data are missing because single episodes were rejected by raters as "not scorable" if signs of uneasiness were evident before the infant had begun to attend to the current stimulus. Data missing because testing was abandoned, or because raters rejected single episodes, amounted to 4% of some 1500 posible episodes. The possibility that the remaining data were biased by these omissions will be examined later.

RESULTS

Throughout most of this section an infant will be described as "wary" if he had responded to the stranger by crying, frowning, or crawling away (i.e., when coded 4 or 5 on the Affect Scale). This is but a descriptive convenience; whether it is actually appropriate to use the same term regardless of the age of the reacting infant will be questioned in a later section.

Reactions to a Stranger--Normative Analyses

An overall view of the onset and subsequent development of wariness is provided by an analysis of Affect Scale ratings. Following this, ratings which focused on discrete aspects of the infants' behavior will be discussed to illuminate processes underlying the overall patterns of developmental changes. Since there were no indications of significant order effects, observations from repeated trials within an age have been combined (5).

The Onset and Growth of Wariness

Although a few studies have reported instances of a much earlier appearance, the consensus of previous research has set the onset of wariness late within the first year of life (see Bronson, 1968a). An acceptance of this chronology raised questions as to why wariness is delayed for some months beyond the age at which infants begin to discriminate strangers (see Bronson, 1968b). The present study, however, indicates that signs of wariness appear earlier than previously believed, making the issue spurious: babies appear to be occasionally wary of strangers as soon as they can clearly identify them. With regard to its subsequent development, the wariness (or "fear") of strangers has sometimes been viewed as a phenomenon which increases to a peak intensity and then wanes, although there is little agreement as to just when the peak period might occur (see Morgan and Ricciutti, 1968). Although not conclusive, the present evidence suggests that this may be an oversimplification: the proclivity to be wary may remain, but with its expression taking different forms and with the category of "strangers" becoming rather more limited as infants grow older.

Consider first the age of onset. It is evident from Figure 1 that signs of wariness began to appear as early as the fourth month of life (rater agreements are given in Table 3). Furthermore, these early manifestations of wariness were not limited to a few infants--almost half of the sample (15 babies) were rated as wary on at least one of the 8 stranger episodes presented within this age period (6). And by the next assessments at age 6-1/2 months a cumulative 78% of the sample had shown signs of wariness in at least one stranger episode. In brief, although unequivocal smiling was the most frequent reaction, most infants had shown occasional wariness toward the stranger by around the middle of the first year. It will be shown later that probably both differences in temperament, and the differential development of discriminative abilities, contributed to individual variations in age at which wariness was first observed.

Two procedural differences between the present study and those reporting no signs of wariness before the latter part of the first year can reasonably account for the different results. First, the use of repeated within-age trials considerably increased the probability of observing the response in a given infant. Second, as will be shown below, crying at these ages was always preceded by rather prolonged inspections of the stranger's face; in the studies at issue, however, proximity to the stranger was limited to intervals lasting only 8 to 10 seconds (i.e., Morgan and Ricciutti, 1968; Scarr and Salapatek, 1970; Schaffer, 1966, per personal communications from the authors). Studies which used longer exposures have all reported some instances of wariness in infants as young as 3 or 4 months (i.e., Bronson, 1969b; Pulver, 1959b; Rheingold, 1961; Tennes and Lampl, 1964; and perhaps Zelazo, 1971).

When reactions in equivalent situations are compared across ages the incidence of wariness showed a continued increase throughout the study period: from Figure 1 it can be seen that when tested in their cribs at 3 and 4 months infants were wary in about 20% of the episodes; the incidence increased to 32% when in the infant seat at 6-1/2 months; and on the floor at 9 months it was up to 47%. Although similar increases through the second half-year have been reported in a number of previous studies (Bayley, 1932; Morgan and Ricciutti, 1968; Scarr and Salapatek, 1970; Schaffer, 1966), a closer look indicates that it is hazardous to draw firm conclusions from data based only on selected responses to a specific testing situation. The patterns shown in Figure 1 can illustrate the ambiguities to be encountered in interpreting between-age patterns of changes: if <u>crying</u> is regarded as the criterion for wariness, then infants at 9 months were no more wary when picked up than they were at age 6-1/2 months--and in the other testing conditions they were <u>less</u> wary when older. Only when codings of "uneasiness" are included did the incidence of

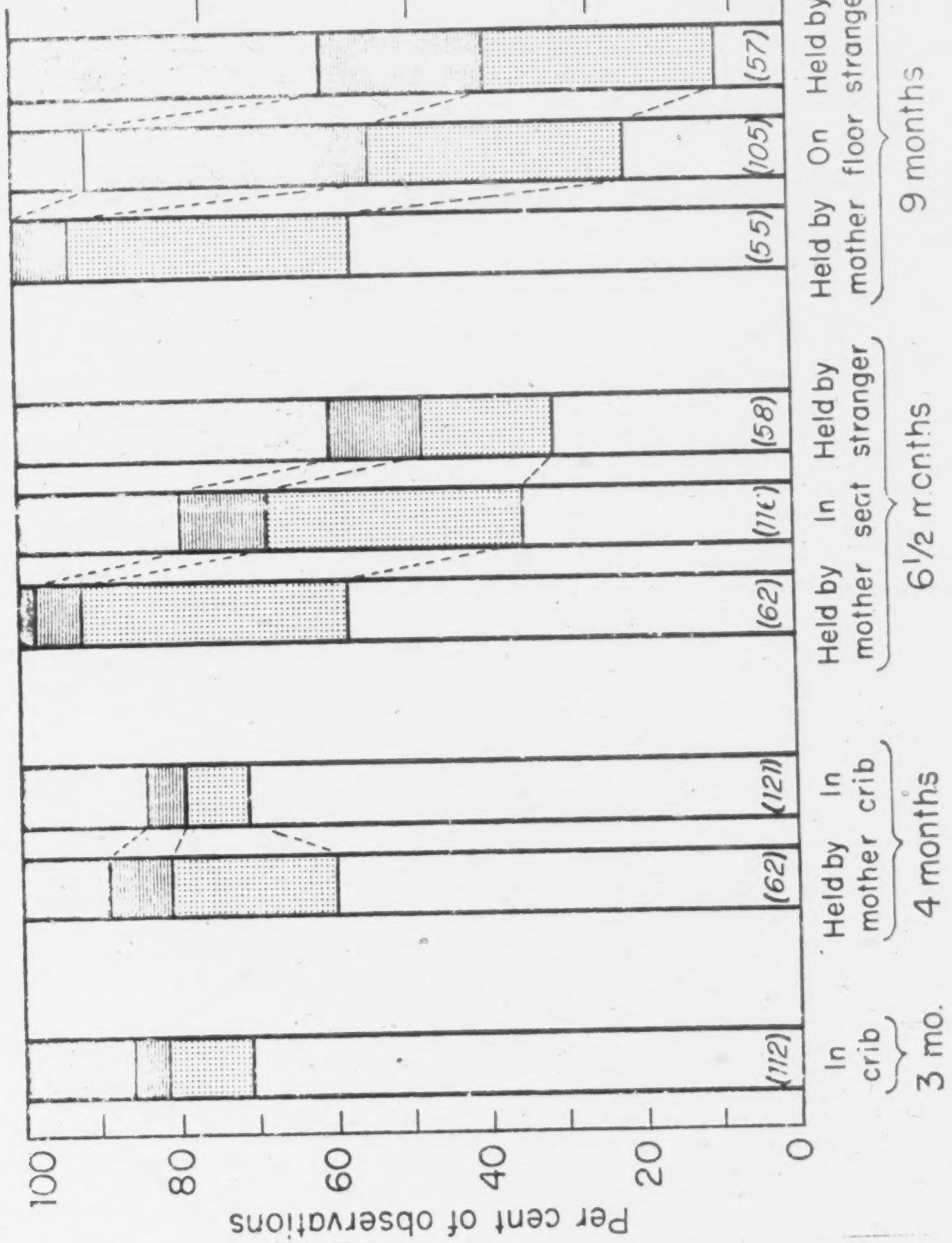


Figure 1. The quality of reactions to a stranger as a function of the infant's age and the circumstances of the encounter. (The first two categories on the Affect Scale have been combined. Total n's are given in parentheses.)

wariness increase with age; however, note that crawling to mother --a frequent basis for inferring uneasiness at age 9 months--was an option not available to infants at the earlier ages. Furthermore, it will be shown later that as they grew older the infants were more able to firmly turn away from the stranger, a maneuver which sometimes enabled them to maintain an apparent composure that masked latent uneasiness. In brief, developmental changes in both mode of expression and in sensitivities to particular aspects of an encounter situation make between-age comparisons of the average "degree" or "intensity" of wariness a hazardous procedure. The present study did not extend to ages at which wariness is sometimes described as waning; however, in view of the preceding it is evident that when based on limited sets of data inferences of change in either direction must be viewed with reservation. The possibility will be explored later that changes may, in fact, be either toward the attenuation or the enhancement of uneasiness, depending on the nature of an infant's social environment.

Effects of the Encounter Situation

It is clear from Figure 1 that (in the second half year) wariness increased when an infant was picked up by the stranger; the effect has been reported previously and needs no further comment (Schaffer, 1966). Being held by the mother also made a clear difference, but in the opposite direction and not at all ages: only when older was wariness reduced by being held in mother's arms (7). Further evidence of the mother's developing ability to provide security is found in reactions to her departing from the room. At ages 6-1/2 and 9 months mother was in view through most of the testing session, and in about half of the stranger episodes the infants occasionally looked at her with either a neutral or troubled expression; in light of these rather frequent references it was surprising that mother's leaving did not consistently produce significant effects. At 6-1/2 months there were no instances of a change in Affect Scale ratings on her departure (baby in infant seat); however, at age 9 months an increased uneasiness was coded in 7 out of the 20 trials (and no changes occurred in the opposite direction; baby on stranger's knee). In addition, by the latter age the infants' newly developed mobility allowed them a further behavioral option which they exercised by crawling to mother in about 1/3 of the stranger episodes. To summarize, under conditions of the present research the mother's ability to reduce wariness in a stranger's presence seemed to follow a developmental pattern: at 4 months there was little indication that mother could lessen wariness by (loosely) holding her infant; by 6-1/2 months being held decreased wariness, but mother's departure from the visual field made no apparent difference; by 9 months holding by mother continued to be effective, her visual presence had apparently begun to provide some degree of security, and infants often sought her proximity when the stranger approached. It seems evident that with the growth

of attachment the mother becomes an increasingly effective agent in providing security to the infant.

The Nature of the Earliest Signs of Wariness

Evidence reviewed in 2 previous publications (Bronson, 1965 and 1968a) has suggested that the ontogeny of aversive reactions might be viewed as a 2-stage process. The distress reactions present in the first months of life--e.g., crying or startling in response to sudden or intense stimuli--fall within the mediational capacities of sub-cortical neural systems. With the maturation of neocortical systems that mediate pattern recognition and discrimination, configurational properties of a stimulus are added to the qualities that can produce an aversive reaction; crying at a strange face is probably the earliest expression of this newly emerging capacity. The notion that early distress reactions are precursors of the wariness provoked by unfamiliar patterns gains indirect support from present findings: it will be shown that infants who were particularly prone to distress in the first months of life were, when they grew older, more intensely wary of strangers. Although still tentative, the thesis that early expressions of wariness represent an activation of existing response systems by a new domain of adequate stimuli remains viable. Initially, the predominant reaction is unchanged from the earlier stage--the infant cries. The subsequent emergence of a wider variety of response options will be examined in the section that follows; for the moment, consider evidence that the growth of discriminative capacities is a sufficient explanation for the appearance of wariness (8).

Intermixed with the repeated smiles that characterized reactions at 3 and 4 months were instances in which babies stared long and fixedly at the stranger, and on some occasions the infants began to cry--i.e., the onset of wariness seemed to be coincident with the development of discriminative ability. That the infants experienced considerable difficulty in making these initial discriminations is indicated by their frequent long inspections of the stranger's face, the unpredictability of their reactions from one trial to the next, and the fact that if crying did occur it was never an immediate response to the stranger.

At age 3 months the prediction of an infant's response from one visit to the next was scarcely better than chance, even though a moderate degree of consistency was found between the 2 stranger episodes of a single visit; by age 4 months, however, individual reactions had become considerably more consistent both within and between visits (see Table 3). More striking indications of uncertainty are the instances in which an infant's response changed markedly within a single stranger episode (cf. Item a: changing reaction). In 3/4 of such instances the smile preceded signs of wariness: typically, after greeting the stranger with a passing smile the infant would stare intently for some 15 to 30

seconds, then begin to frown, breathe heavily, and finally to cry. The pattern was found only at the younger ages--an incidence of 9% at 3 months and of 4% at age 4 months. Presumably the initial smile was evoked when the stranger's characteristics were assimilated into an existing schema of the human face, only to disappear as, with continued inspection, a dim perception of incongruence emerged. Such vacillations based upon a shifting interpretation of the stranger's perceptual characteristics would be expected to wane as the infants grew older and new persons could be quickly and unequivocally identified.

The frequent long, motionless, inspections of the stranger's hovering (and speaking) face give further evidence of a dawning but tenuous discrimination of strangers. The durations of the longest continuous regards that occurred in each stranger episode are shown in Figure 2: clearly it is only when younger--at 3 and 4 months--that infants engaged in protracted examinations of the stranger's face. During these long regards the infant's expression was rated as "neutral" (on the Affect Scale) in 97% of the occurrences. Brief inspections at ages 3 and 4 months inevitably terminated in a smile; at the 2 older ages, however, brief inspections most typically ended by turning away from the stranger--a pattern that is examined in the following section.

Finally, there is evidence that at 3 and 4 months an aversive reaction could be mobilized only after a fairly considerable delay. Figure 3 indicates the elapsed times between the stranger's appearance and the beginning of crying, or to the infant's first smile. It is evident, at every age, that if an infant was going to smile at all the probability strongly favored an initial occurrence within the first 10 seconds; however, apart from reactions at 9 months which will be considered separately, crying almost always made a delayed appearance. The nature of the infants' behaviors in the intervals before the onset of crying indicate that the causes of delay at 3 and 4 months were different from those operating at 6-1/2 months. The younger infants stared almost continually at the stranger before beginning to cry, spending thus an average of 77% of the delay period. At 6-1/2 months, however, there was a sharp decrease in cumulative inspection times to an average of only 38%; since by now the uneasy infants actively avoided looking at the stranger (see below) the delay at this age can be attributed to the infants' exercise of defensive maneuvers. (Data on 9-month-old infants were omitted because they were minimal and not directly comparable. Now being mobile, disturbed infants frequently crawled to mother; this maneuver, plus a well-developed ability to minimize visual contact, led to infrequent crying in the stranger episodes. In the few instances of crying it began immediately after the stranger appeared--e.g., in 6 of the 10 instances the delay was 5 seconds or less.)

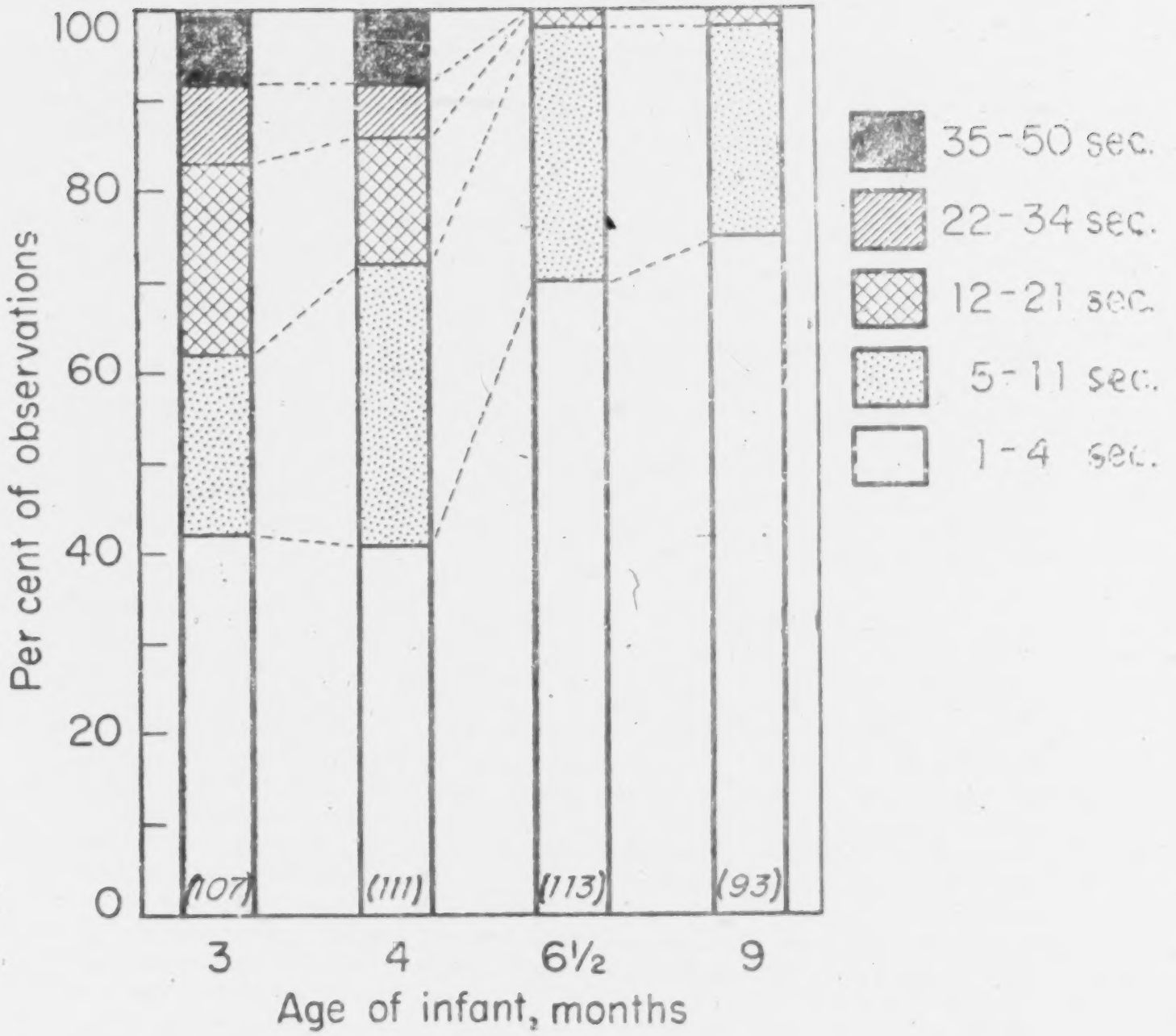


Figure 2. Duration of the longest continuous inspection of the stranger's face (total n's in parentheses).

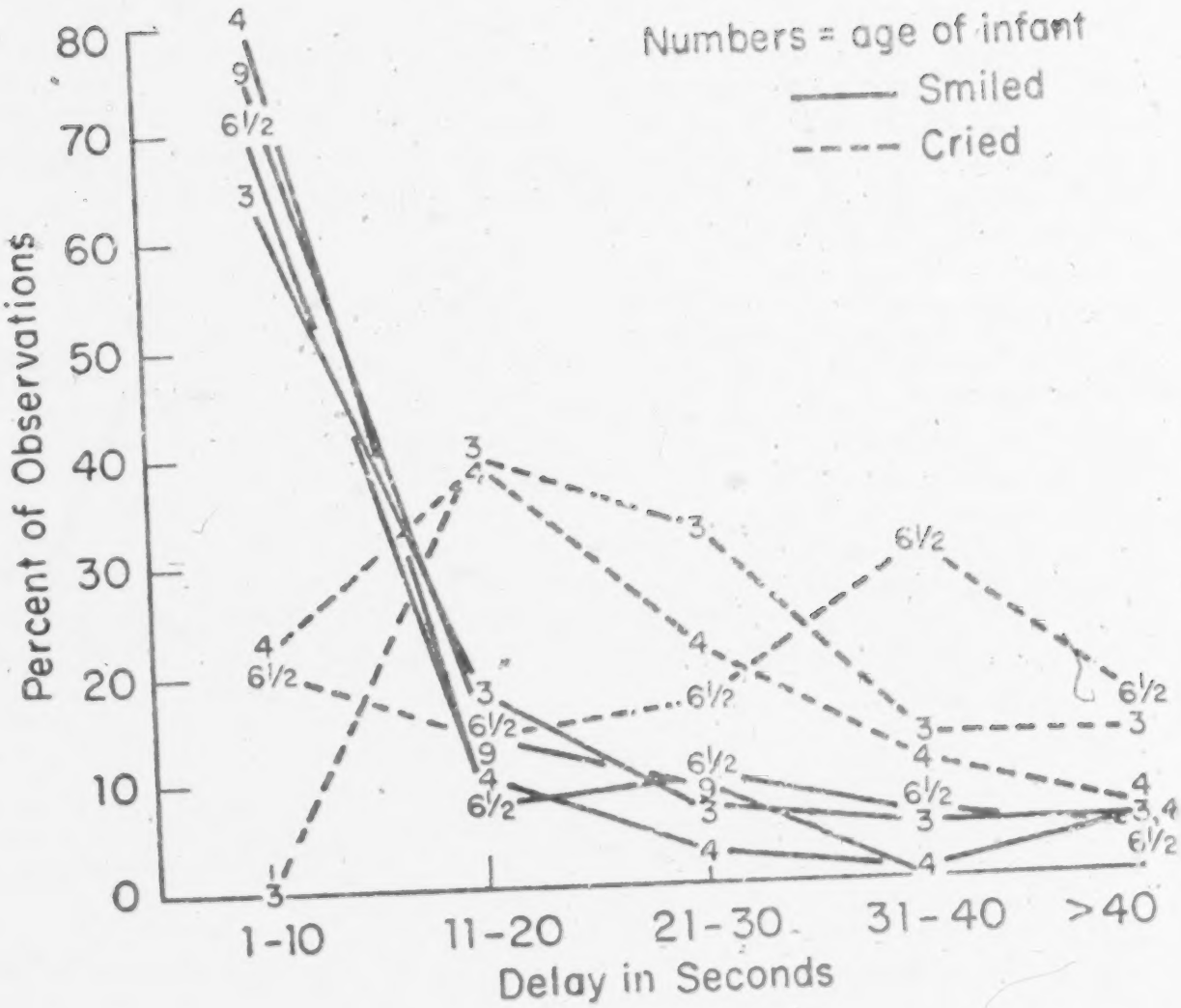


Figure 3. Delay before the first smile or to the beginning of crying. (N's, for smiling and crying respectively: 3 months, 80 and 15; 4 months, 85 and 19; 6-1/2 months, 52 and 25; 9 months, 21.)

Developmental Changes in the Expression of Wariness

Increasing age brought an expanding range of options for the upset infant. The most evident of these has already been noted: when so able, infants frequently crawled away to mother. Another pattern--turning away from the stranger--emerged with increasing persistence during the second half year; however, before accepting the behavior as indicative of wariness the basis for such assertion must be established.

Turning away was coded on the Gaze Aversion scale, from "(1) Infant showed no resistance to looking at the stranger," through "(3) Infant consistently looked at the stranger in response to his verbal commands, but always turned away after a glance of one or two seconds," to "(5) Despite repeated verbal commands the infant gave only infrequent fleeting glances toward the stranger." (Rater agreements averaged r=.87; episodes that lasted less than 10 seconds were omitted as too brief to score). The association between turning away from the stranger and Affect Scale ratings is shown in Table 2; the 2 early ages are omitted since visual avoidance was not firmly established at these ages. It is evident that

Table 2
Incidence of Strong Visual Avoidance as a Function of the Affective Tone of the Episode

Age in Months	Affect Scale Rating: Smiled	Neutral	Uneasy or Cried
6-1/2	10% (40)	37% (38)	15% (27)
9	0% (20)	47% (32)	31% (26)

Note. Strong Visual Avoidance refers to Gaze Aversion scores of (4) or (5). Values in parentheses show the numbers of coded episodes within each Affect category.

gaze aversion was rare or absent in episodes in which infants frequently smiled at the stranger, yet it occurred fairly often otherwise--hence an association with some degree of wariness is indeed indicated. Further, note that at both ages the incidence of avoidance behavior was higher when infants were rated as "neutral" than when they showed evident signs of unease. This suggests that some babies rated "neutral" might not have been as undisturbed by the stranger as their facial and vocal behaviors indicated, but managed to maintain composure by strongly resisting visual contact. Support for the hypothesis is found in the 6-1/2 month observations: 83% of the instances in which babies appeared

"neutral" yet strongly resisted orienting toward the stranger were followed by overt signs of unease in the following Pick-up episode, whereas in the Pick-up episodes of "neutral" babies who had not strongly avoided contact the incidence of wariness was only 30% (based on Affect Scale ratings of 4 or 5 in response to pick-up, Fisher's exact probability significant at $p < .06$, one tailed test; total $n = 16$). (At age 9 months the test of the hypothesis could not be repeated since the babies by then proved capable of limiting visual contact even when the stranger picked them up; presumably because of this continued visual avoidance, the babies at issue usually continued to appear "neutral" in affect even when on the stranger's knee.) It is reasonable to conclude that visual avoidance can be a valid indication of uneasiness, and that it is effective in aiding an infant to maintain composure in the presence of a disturbing stranger.

As the infants grew older there was a marked increase in visual avoidance of the stranger. Was this due only to the age-related increase in wariness, or might an infant's ability to resist orienting toward a verbally insistent stranger be a developmental phenomenon in itself? To examine the latter possibility the effect of increasing wariness with age was largely eliminated by considering only Stranger episodes in which babies had been rated as "neutral," "uneasy," or "cried." The data, summarized in Figure 4, do suggest a developmental progression: at 3 months there were relatively few instances in which non-smiling babies turned away from the stranger, and essentially no evidence of a capacity to resist orienting on verbal command; by 4 months turning away had become fairly frequent, but the infants still could not resist looking briefly toward the verbally insistent stranger; by 6-1/2 and 9 months, however, babies not only frequently turned away but often strongly resisted giving even a brief glance at the stranger. While turned away from the stranger the infants remained largely immobile, although at the 2 older ages they sometimes engaged in small-muscle movements, e.g., picking at a rug, or slowly fingering the toy dog.

Finding that infants often firmly turned away in a stranger's presence raises some basic questions concerning the adaptive functions of wariness. It has been suggested that wariness of the unfamiliar evolved to provide protection against unknown hazards, such as from predators (cf. Freedman, 1961; King, 1966)--but survival in such situations would hardly be served by this kind of behavior. However, the response might play a functional role in limiting attachment behaviors to familiar caretakers, or as a coping technique that does not preclude an eventual active engagement. The situation might be clarified by assuming that the form in which wariness finds expression is determined by the nature of competing orientations concurrently activated by the particular unfamiliar stimulus--the response then will differ depending on whether it is evoked by a conspecific, or by an unusual event in the non-human environment.

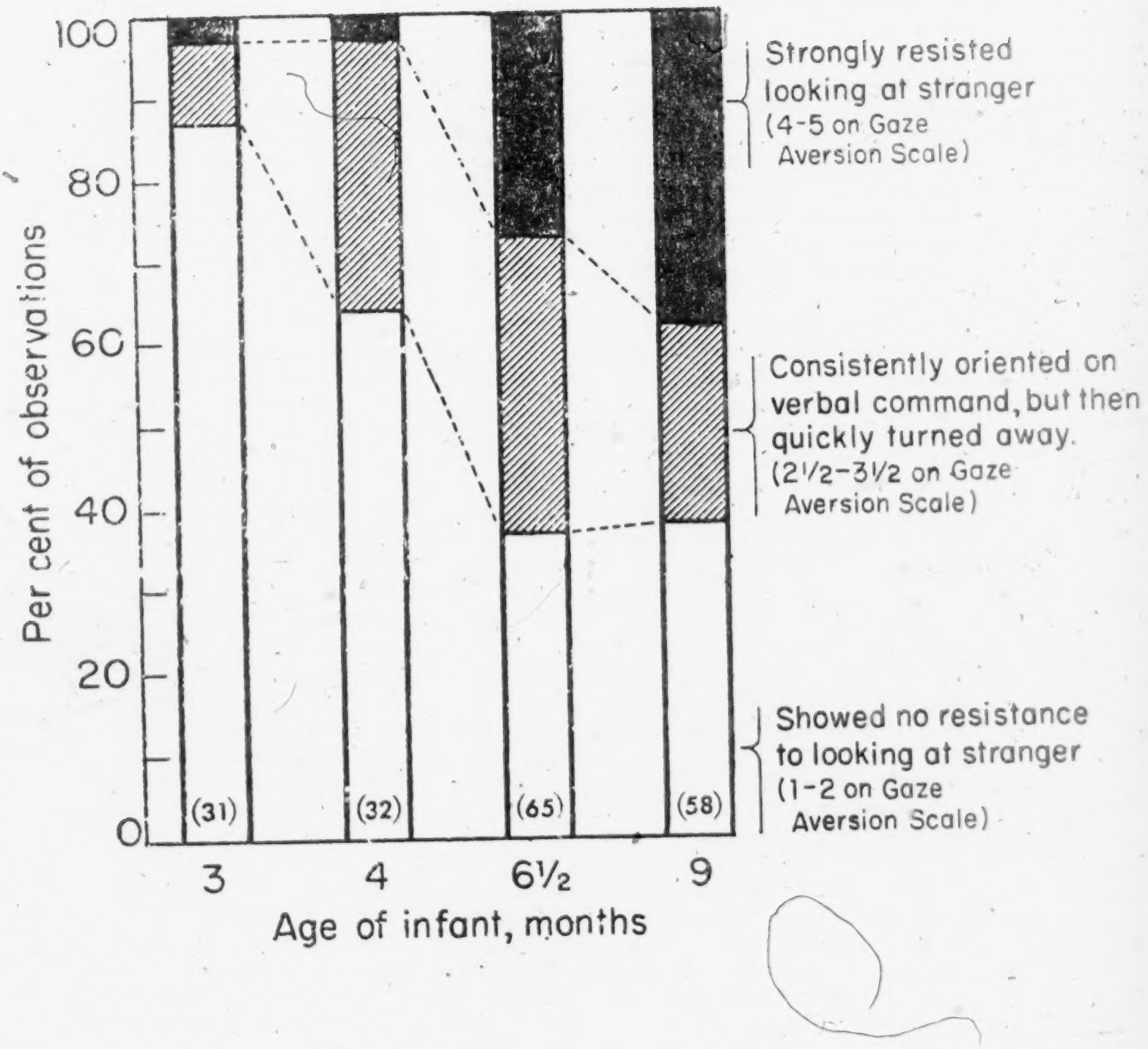


Figure 4. Frequency and intensity of gaze aversion (total n's in parentheses).

The issue can be pursued a bit further, but first it is necessary to examine evidence of the growing complexity of an infant's orientation toward the stranger. Coded on Checklist item b: Ambivalent reaction were instances when the infant seemed both pleased and made wary by the stranger's presence. Such reactions were non-existent at 3 and 4 months, but occurred in 5% of the 6-1/2 month stranger episodes, and in 11% of the 9 month observations. (At the younger age ambivalence was typically shown by giving a brief smile, then quickly bowing the head and resisting further visual contact; at 9 months it was also seen in the form of smiling and simultaneously beginning to crawl to mother.) From this perspective, the age-related increase in the frequency of "neutral" responses to the stranger (cf. Figure 1) could be interpreted as evidence of infants' growing abilities to simultaneously entertain conflicting emotions: when older, babies may be inclined toward both affiliative behavior and escape. If so, the turning away from a stranger which was frequently associated with a "neutral" rating (cf. Table 2), might prove to be an expression of wariness unique to encounters with conspecifics; being limited to situations in which an affiliative orientation and wariness are simultaneously aroused, it would not be elicited when wariness is provoked by aspects of the non-human environment. The hypothesis finds some support in the absence of gaze aversion behavior in the few instances in which wariness was elicited by a novel object (see below).

Reactions to a Stranger--Individual Differences

Two broad issues arise in the analysis of individual differences. The first concerns the degree to which individual infants were consistent in the relative degree of wariness shown at different ages. In analyzing the data from this perspective the aim is to go beyond a demonstration of greater than chance continuity; of equal theoretical interest is the demonstration of significant discontinuities in the developmental patterns of identifiable groups of infants: If behavior is indeed affected by the quality of an infant's environment such developmental discontinuities are to be expected. The second issue centers on identification of factors, within the infant and in his environment, which promoted both the continuities and the discontinuities in individual patterns. The following section examines patterns of developmental continuity in infants' reactions to the stranger, and considers one of the factors associated with variations in age of onset of wariness. Succeeding sections examine additional factors that may have promoted differences in both age of onset and in the degree of wariness found at later assessment ages.

The Developmental Continuity of Differences in Wariness

An index descriptive of an infant's overall response to the stranger at each age must be established, and its reliability

estimated, before age-to-age continuities can be meaningfully examined. Ratings coded on the Affect Scale proved to be the most reliable in discriminating among different infants, and were therefore selected as the best basis for assessing individual continuities. The correlations between the repeated trials of each age are shown in Table 3. From age 4 months onward the responses were moderately consistent; however, the 3-month assessments proved too unreliable to be useful for a longitudinal analysis--indeed, it was not unusual at this age for an infant to smile on some trials and cry at the stranger on others. From 4 months onwards infants were also moderately consistent between the different encounter situations: average reactions in the Stranger episodes correlated with responses when held in mother's arms at 4 months r=.84; at ages 6-1/2 and 9 months they correlated with reactions in the Pick-up episodes r=.78 and r=.63, respectively.

Table 3
Affect Scale Ratings: Rater Agreements and Within-Age Reliabilities

Age in Months	Encounter Situation	Average Rater Agreement[a] (Avg. n=29)	Within-Age Reliabilities: Within visits[a] (Avg. n=27)	Within-Age Reliabilities: Between visits (Avg. n=29)
3	In crib	.93	.58	.32
	Held by mother	.93		.82
4	In crib	.96	.91	.79
	Composite index			.84
	In seat	.92	.90	.66
6-1/2	Picked up	.96		.63
	Composite index			.75
	On floor	.97	.87	.68
9	Picked up	.96		.67
	Composite index			.76

a. Averages of two or more correlation values.

In brief, beyond age 3 months assessments of an infant's reactions were sufficiently consistent across trials and situations to support the averaging of scores into a composite index reflecting an infant's overall behavior at the given age. The between-visit reliabilities of the resulting Composite Affect Scale for each age are given in Table 3 (9).

Correlations reflecting age-to-age continuities in the reactions of individual infants are shown in Table 4. Although significant continuities do occur, the total-sample values (above the diagonal) are considerably lower than the limits imposed by the estimated measurement reliabilities (diagonal values), indicating that extraneous factors had been differentially affecting the development of individual infants (10). An examination of the scatter-plot of the 4-by-6-1/2-month correlation showed that deviations from a linear pattern were not random: all highly deviant cases fell into one quadrant. These were infants who gave no indication of wariness at 4 months, but were rather consistently upset by the stranger at the next assessment age. On the possibility that prediction for the deviant babies was poor from age 4 months because they were as yet unable to clearly distinguish a stranger, correlations from 4 months onward were re-computed after eliminating all infants who had not demonstrated discriminative ability by showing signs of wariness at least once during the 3- or 4-month assessments. These values are given below the diagonal in Table 4. The 4-by-6-1/2-month value did prove to be considerably larger than that for the total sample (and the correlation among the "eliminated" infants was nil, $r=-.01$), indicating that prediction was indeed improved when the sample was limited to infants who had on occasion been wary during the fourth month.

Table 4
Age by Age Continuities in Reactions to a Stranger

	Age in Months		
	4	6-1/2	9
4	(.91)	.43*	.46**
6-1/2	.75**	(.86)	.32
9	.49	--	(.86)

Note. Total sample values are shown above the diagonal (average n=29); infants who were on occasion wary in the fourth month are represented below the diagonal (average n=13). Reliability estimates in diagonal cells are Spearman-Brown corrections of Table 3 between-visit reliabilities.

* $p < .05$
** $p < .01$

That the limiting factor was an inability to clearly distinguish a stranger, however, remains uncertain since no direct measure of discriminative ability was available (11). (An equal number of male and female infants were eliminated in refining the sample.)

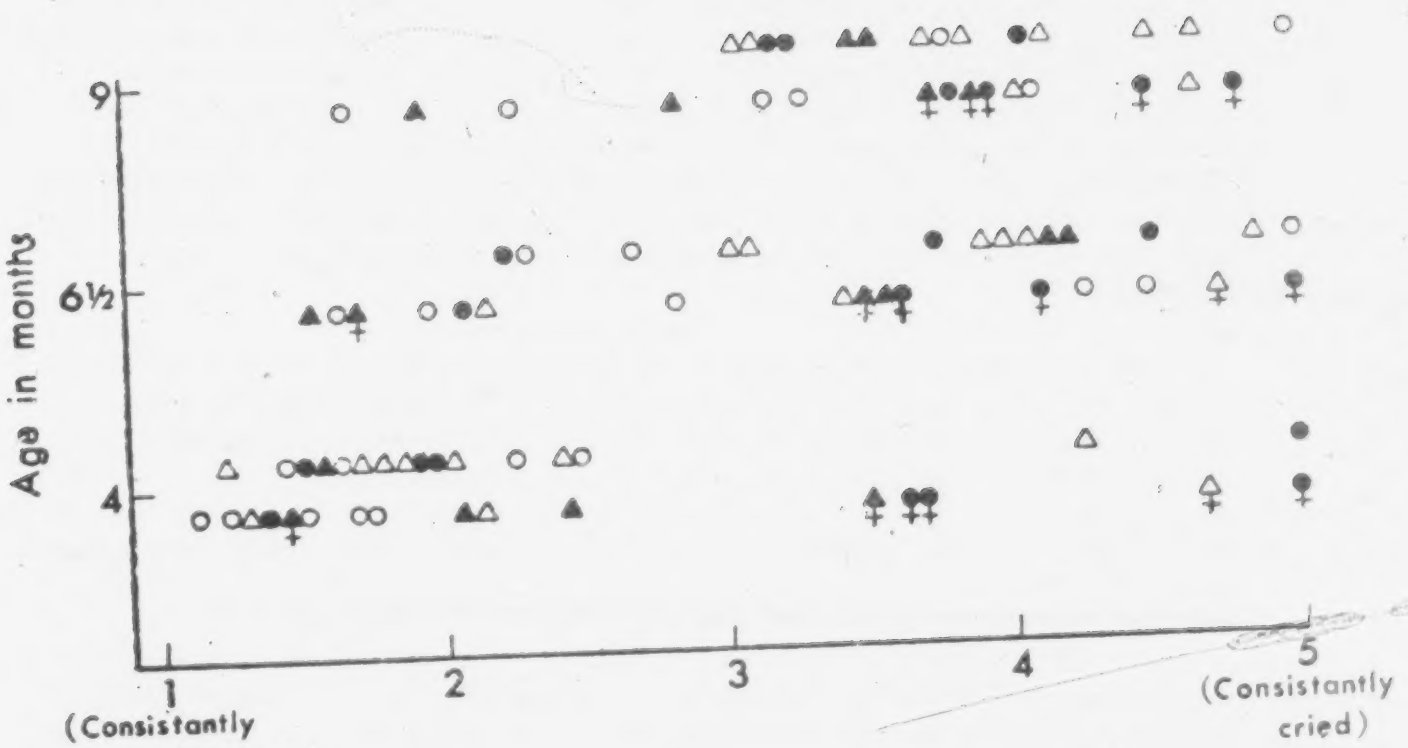
The Composite Affect Scale scores for each infant at each age are shown in Figure 5, and the infants are designated by sex, birth order and ancestry. None of these categories were consistently related to the quality of stranger reactions given during the second half-year; however, at age 4 months highly wary infants were more often to be found in the Caucasian group and they tended to be firstborn infants. A probable explanation for these early group differences emerges from analyses presented in the following section.

The Effects of Temperament: Early Variations in Reactivity

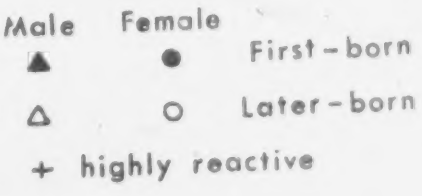
Recurrent in the clinical literature is the notion that extremely shy children had often appeared as infants to be hyperreactive to stimulation (e.g., Bergman and Escalona, 1949). This suggests that differences in infant temperament may, at least occasionally, have a profound effect on early wariness reactions. Measures designed to test this possibility were included in the research program; they are collectively designated as measures of "infant reactivity." The various measures will be discussed separately, and their communality assessed, before their relations to infant wariness are considered (12).

The Persistence of Crying. During the first rather extended home visits infants were rated on a Persistence of Crying scale from "(1) No crying, or baby quickly quieted," to "(5) Baby recurrently cried unless being held in mother's arms" (13). The distribution of ratings proved to be highly skewed, with about 2/3 of the sample scoring at the low end of the scale (rater agreement: $r=.97$). There were no differences between the sexes, but 8 of the 10 infants given to some degree of recurrent crying were Caucasian infants, 6 of whom were first-born babies.

Early Reactions to Bathing. Three interview items aimed at assessing the degree to which an infant seemed prone to distress during the first and second months of life: mothers were asked about the overall amount of crying, about startling or crying at sudden sounds, and about crying in response to being bathed. Only the latter item provided unequivocal statements from mothers (14). Responses were coded on a scale from "(1) Baby was never upset at bathing," to "(5) Baby had consistently cried on being bathed." Distribution on this scale also proved to be highly skewed, with about 2/3 of the mothers reporting no distress at bathing during the first 2 months of life. There were no differences between the sexes, but the 7 highest scoring infants were all first-borns, and 6 of these were Caucasian babies.



A. Reaction to strangers – mean affect scale score



B. Degee of reactivity

Figure 5. A: Average reactions of individual infants to a stranger. B: Degree of Reactivity shown by different infants. (Upper distributions in each set represent Oriental infants, and the lower, Caucasian infants.)

Reactions to a Looming Stimulus. The rapid opening of a parasol was included among the video-recorded episodes to assess possible differences in response to a sudden looming stimulus. In no instance did a baby turn away on presentation of the stimulus, and only once, in a 3-month-old baby who startled very strongly, did it induce crying; at the 2 older ages infants sometimes smiled at and occasionally reached for the parasol. Opening induced frequent reactions, but closing rarely did; the slight rustling sound that accompanied both the opening and closing was not, therefore, the significant component of the stimulus, although it may have added impact to the visual "looming" effect. Reactions were coded for both the incidence of blinking and for startle responses.

At all ages the incidence of blinking ranged from 0 to 100% of the trials, and distributions proved to be moderately even across the entire range of the scale. Initially low between-visit reliabilities increased with age: at 3 months $\underline{r}$=.18; at 4 months $\underline{r}$=.29; at 6-1/2 months $\underline{r}$=.65; and at 9 months $\underline{r}$=.74 (rater agreements were 100%). The continuities of individual reactions between ages also increased as infants grew older, see Table 5. At no age was there evidence of a sex difference. However, as the infants grew older an increasing difference appeared between the Caucasian and Oriental babies in the sample: at 3 months both groups blinked, on the average, in about half of the trials; the average incidence of blinking in Caucasian infants subsequently increased to about 2 out of 3 trials by 9 months, while Oriental infants decreased steadily to an average incidence of 1 in 3 trials by this age.

Table 5
Consistencies of Incidence of Blinking (above diagonal; average n=30), and Degree of Startle (below diagonal; average n=30) in Response to a Looming Stimulus.

	Age in Months			
	3	4	6-1/2	9
3	--	.44	.30	.23
4	.72	--	.59	.40
6-1/2	.49	.59	--	.66
9	.01	.11	.52	--

Startle reactions were coded for both the frequency and intensity of the reaction. A comparison of the retest reliabili-

ties of the 2 measures showed the intensity of startle to be the more reliable, and it was therefore selected as the better index of individual differences (15). Between-visit reliabilities were: 3 months, $\underline{r}$=.55; 4 months, $\underline{r}$=.42; 6-1/2 months, $\underline{r}$=.59; 9 months, $\underline{r}$=.25 (rater agreement averaged $\underline{r}$=.96). Distributions at all ages proved to be highly skewed. At ages 3 and 4 months about half of the infants never showed any startle responses; among the infants who did, firstborn infants were more likely to give a stronger reaction, and the several highest scores always came from the Caucasian sample. At the 2 older ages the distributions for the Caucasian infants remained approximately the same as at ages 3 and 4 months, whereas startle responses among the Oriental infants decreased markedly, with only one startle appearing in all of the 6-1/2-month trials, and none at age 9 months. Between-age continuities in startle reactions are given in Table 5.

(Note that blinking and startle behaviors showed divergent developmental patterns: in the case of blinking the incidence held constant and both the reliability and the age-by-age continuities increased steadily with age, whereas startles became less frequent and less predictable during the second half year. Although it is assumed that both responses were in part determined by the degree of "reactivity" characteristic of a given infant, there is reason to believe that in another respect the determinants differed. Findings from other studies show that skeletal reactions to a looming stimulus are present at or shortly after birth, whereas a blink reaction appears to be dependent upon prior visual experience, and begins to appear with increasing frequency during the third month of life (16). If blinking at looming objects was a newly emergent behavior when first assessed it might be expected that the consistency with which it was elicited would initially be low.)

Relations among Reactivity Measures. It was repeatedly noted in discussing the individual measures that the highest scores usually came from Caucasian infants; as a result, the predictable variance between pairs of measures was largely carried by subjects from this group. To illustrate the effect the intercorrelations among measures given in Table 6 are shown for the Caucasian subgroup as well as for the total sample. It can be seen that apart from the blink reactions the measures shared a fair degree of common variance; a composite index was determined by averaging individual scores across the 4 measures. Distributions of scores on the composite Reactivity Index are shown in Figure 5, which identifies infants by sex, ancestry, and birth-order. The group differences that were repeatedly noted in discussing the individual measures were subjected to tests of statistical significance: infants from the Caucasian sample were more likely to show a high degree of reactivity (U-test significant at p=.07 for n's of 16 and 16), and within this group firstborn infants consistently contributed the highest scores (U-test significant at $p < .02$,

n's of 8 and 8). The first of these differences gains support from a study by Freedman and Freedman (1969) which reported rather similar differences between samples of Caucasian and Chinese infants tested at birth. The birth-order difference is more tenuous: the samples were very small, and the literature in this domain is equivocal, although most studies seem in accord with present findings (e.g., Bell, 1971; Collard, 1968; DeFee and Himelstein, 1969; Waldrop and Bell, 1966--reporting an opposite effect, Weller, 1965).

Table 6
Correlations among Measures of Infant Reactivity

	(1) Persistence of Crying	(2) Distress at Bathing	(3) Degree of Startle	(4) Incidence of Blinking
(1)	--	.51	.30	.17
(2)	.58	--	.47	.20
(3)	.39	.49	--	.55
(4)	.12	.21	.57	--

Note. Total sample values are shown above the diagonal (average n=32); Caucasian infants only are represented below the diagonal (average n=16).

The Relation of Reactivity to Wariness. Shown in Table 7 are correlations between the various measures of early reactivity and the Composite Affect Scale measure of degree of wariness. Total sample correlations are given in addition to those obtained for the Caucasian infants alone, although the latter are of greater interest since in the present sample it was only among the Caucasian group that the more highly reactive infants were to be found. All measures appear to be related in some degree to stranger reactions at 4 months, the more highly reactive infants being more likely to show wariness toward the stranger. The effect was stronger among the Caucasian infants, and the association was greatest for startle behavior and least with the incidence of blinking--all findings that could be expected from previous discussions. Prediction of wariness from early assessments of infant reactivity clearly decreased as the infants grew older (17).

Since many of the measures were highly skewed the correlation coefficients given in Table 7 can only roughly summarize relationships between pairs of variables. Another perspective is provided in Figure 5A, in which 6 infants are identified who were notably

Table 7
Correlations between Measures of Reactivity and Composite Affect Scale Scores

Age in Months	Composite Reactivity Index	Persistence of Crying	Distress at Bathing	Strength of Startle	Incidence of Blinking
4	.82 (.54)	.61 (.43)	.62 (.33)	.81 (.59)	.43 (.33)
6-1/2	.38 (.12)	.32 (.09)	.15 (-.15)	.31 (.17)	.45 (.32)
9	.34 (.12)	.52 (.30)	.25 (.08)	.17 (-.01)	.06 (-.04)

Note. Main values are for the Caucasian infants only (average n=16); values in parentheses are for the total sample (average n=30).

highest on the composited Reactivity Index (cf. Figure 5B). At age 4 months a high degree of reactivity was a major determinant of wariness toward a stranger (U-test significant at $p < .02$ for n's of 6 and 26). As they grew older the small group of highly reactive infants remained among the more wary babies--however, note that at the older ages an appreciable number of other infants began to show comparable levels of wariness. Two kinds of explanation might be offered to account for the subsequent increase in wariness found among less reactive babies: perhaps reactivity levels increased in these infants as they grew older; or perhaps developmental processes of some other kind began to promote a heightened wariness of strangers. Analysis of the age-related changes in patterns of startle and blink reactions argues against the former explanation. It was noted earlier that on both of these measures the scores of Oriental infants decreased with age, whereas Caucasian infants remained the same on startle and increased in the frequency of blinking. Reference to Figure 5 shows that over this same age period, however, the early tendency for Oriental infants to be relatively less wary first disappeared and then slightly reversed. In light of these opposing age trends it is unlikely that increasing levels of reactivity were responsible for the subsequent increase in wariness shown by some infants (18). Other explanations for differential rates of change will be considered below.

In summary, there is strong evidence that infants differ from the first months of life in the degree to which they show aversive reactions to certain kinds of external stimuli, and that such differences are predictive of the degree of wariness induced

by a stranger when the infant is older. A similar pattern was found in a previous study (Bronson, 1969a), but only among the female infants in the sample. Since firstborn infants were more often highly reactive, further support is found in Schaffer's (1966) report of significantly greater wariness among the first-born infants of his sample. The kinds of stimuli that elicited these early differences in reactivity--i.e., immersion in water (rough handling seemed ruled out by mothers' descriptions), and a sudden looming stimulus--are capable of mediation by sub-cortical networks, which suggests that differences in "reactivity" of the reticular activating system may underly these early variations in infant temperament (see Berlyne, 1960; Bronson, 1965; Hutt and Hutt, 1968; Melzack, 1968). The degree to which such early differences may remain developmentally stable into early childhood is not known.

The Effects of Experience

Measurements of individual differences were sufficiently reliable to demonstrate that the development of wariness followed different patterns in different infants (cf. Table 4). Undoubtedly environmental factors contributed to these variations in developmental profile, and ideally it could be shown that the impact of the environment varied, depending on the nature of the infant (e.g., his relative reactivity)--but the present study falls short of such an achievement. It is possible, however, to tentatively identify significant environmental factors, and to suggest the ages at which they first become operative.

The Quality of Maternal Care. It was shown that as the infants grew older contact with mother became increasingly effective in reducing wariness. Does it follow that the intensity of wariness was also affected by the quality of mothering that a baby experienced?

Mothers' behaviors with their babies were coded both at the initial extended home visits and after completing the 6-1/2-month assessments (19). Scales were developed from the extensive descriptions of mothering behavior developed by Ainsworth (20); one went from "(1) Consistently recognizes baby's mood or desire, and responds with sensitive attention," to "(5) Seems obtuse or indifferent to baby; treats him as an object needing only routine care"; the other from "(1) Clearly enjoys taking time to talk, smile or fondle during routine tending," to "(5) Limits attention to necessary caretaking." Rater agreements (available only on the 3-month assessments) were r=.71 and r=.68. The scales proved to be highly correlated (r=.77), and there was moderate consistency between ages (r=.66), so the ratings were averaged into a single set of Maternal Care ratings. Distribution on the composite scale was approximately normal, and there were no meaningful differences related to the sex of the infant or between the

Caucasian and Oriental mothers in the sample.

Relationships with the Composite Affect Scale ratings of wariness for ages 4, 6-1/2 and 9 months were for males r=.39, r=.57 and r=.31; for females r=-.15, r=-.05, and r=-.39 (average n's of 15; only the 6-1/2-month value for males reached the .05 level of significance). It appears that at around the middle of the first year the degree of wariness was indeed related to the quality of mothering for male infants, but there is no evidence of such an effect among the female sample. Although in itself tenuous, the finding replicates results from a previous study (Bronson, 1971) in which the relation at about this age was strong for males (r=.67) but not for females (r=-.10). A study by Robson, Pedersen, and Moss (1969) suggests a similar pattern of sex differences (21). The curious pattern of sex differences, plus the attenuation of the relationship for males at an older age, indicates that the relation between maternal practices and infant wariness is indeed complex. In the absence of more detailed data on patterns of mother-infant interactions at the different ages, and on the neglected domain of infant-father relationships, speculation as to just how parental practices can affect infant wariness would be premature. Insight into such processes, however, must be regarded as basic to the understanding of developing orientations toward the larger social environment.

Exposure to Strangers. It is sometimes suggested that infants will more readily adapt to strangers if they are repeatedly exposed to a variety of persons from an early age. The evidence collected here gives no support to this notion: at no age were reactions to the stranger significantly related to mothers' reports of the number of encounters per typical week with persons outside the home, or with the number of adults living within the infants' homes. When the exposure hypothesis is examined closely, however, these negative findings are not surprising: in its most plausible form it could not be tested by the present data. Whether interest centers on the number of familiar or entirely new persons with whom the infant is in frequent contact, it seems important to ask whether the characteristics of the infant and the circumstances of the encounters are such as to allow the baby effectively to cope, or whether the infant is repeatedly somewhat upset by these early social encounters. Although exposure per se may lessen the degree to which new persons appear strange, so that in the extreme case of an infant reared in near isolation there might indeed be stronger initial reactions to the occasional stranger, a comfortable orientation to the continued proximity of a stranger must ultimately depend on the meshing of interpersonal expectancies--and in infant's adaptive repertoire will expand only through successful encounters. "Getting used to strangers," therefore, must involve active social interchange, and within the normal range of exposures the outcomes must be more important than the sheer variety of social contacts.

Interview material gathered from mothers raised another issue; although the evidence is anecdotal, because it is suggestive of the kind of process which may terminate the period of generalized wariness it warrants a rather extensive consideration. A number of the mothers reported that at around age 9 months their babies developed a specific aversion to some particular person; the immediacy of the reactions indicate that they were provoked by a perceived congruence between the individual's perceptual characteristics and memories of previous distressing encounters. When, as seemed the case in these instances, the object of an aversive reaction has specific internal representation it becomes appropriate to say that the infant is fearful. Although perhaps similar in overt expression, it is important to distinguish fear from wariness: first, the underlying mechanism is based upon an association between the present percept and particular previous experiences; second, the literature on aversive learning predicts that a specific fear will prove more enduring than wariness, since the latter should wane fairly rapidly if the stranger behaves in a predictable manner. Thus a third category of aversive reactions may sometimes develop: at successive ages infants may be distressed, wary, or fearful. From this perspective, the determinants of aversive reactions to strangers must become increasingly complex as infants grow older: first, a sudden, loud, or exhuberant approach, then unfamiliarity, and finally similarities to prior upsetting social encounters become capable of eliciting uneasiness. It is probable that stimuli from all 3 categories continue to be potentially effective in older infants, and therefore their effects may sometimes be additive. Furthermore, if it is granted that individual infants may be particularly sensitive to events of one category or another, a further level of complexity can be foreseen --consider, for example, the different time-course that would be predicted for an aversive reaction to the exhuberant approach of a strange male adult in (a) a highly reactive infant, (b) a baby reared in near-isolation, and (c) an infant who had been left with a series of inadequate male caretakers; in the nomenclature of this report the first infant would be distressed, the second baby wary, and the third fearful.

Although aversive conditioning is presumably possible before this period, the available evidence suggests that it is toward the end of the first year that expectations tinged with fear are sometimes aroused by a (more or less) unfamiliar person: the first reports of specific fears appeared at 9 months, and it was also at this age that a few infants began to cry immediately on seeing the stranger (22); congruent with this, Morgan found that at slightly beyond this age about 1 out of 5 babies were upset by the sight of a stranger at a distance (Morgan and Ricciutti, 1968).

The data are tenuous and the inferences indirect, but they are suggestive of processes which may gradually terminate the period of generalized wariness: when accrued experience promotes

the anticipation of pleasure, and provides a range of expectancies (or "plans") adequate for accommodation to the diversities of strangers' behaviors, sheer unfamiliarity should become a less prepotent variable; on the other hand, some infants may begin to develop specific, or perhaps diffusely oriented, fears. In brief, perceived congruences, rather than incongruity per se, will begin to determine infants' reactions. Since babies who are particularly prone to wariness will more often be upset by strangers, they should be, in general, more likely to develop negative expectancies --a hypothesis which finds support from a previous study where "shyness" in the preschool years was found to be associated with an early heightened wariness (in males only; Bronson, 1969a).

Reactions to Unfamiliar Objects

At all ages the objects presented promoted rather consistent exploratory activities--looking at age 3 months, reaching by 4 months, crawling up to the object at 9 months--and few signs of wariness; the only unequivocal signs of wariness occurred at age 9 months, and they were minimal and brief. Being generally benign, the reactions observed at younger ages will be given only brief consideration.

Observations at Three and Four Months

The objects presented at the two younger ages--the mobile, bracelets, and wand--promoted sustained interest and sometimes smiling, but in only 6% of the episodes did an infant react with a frown, and no instances of crying were recorded (23). The babies visually tracked the revolving mobile; and at age 4 months they usually reached for and sometimes grabbed the dangling bracelets. Brief smiles were given to these objects in 30% of the episodes. (Rater agreements averaged r=.88.)

The wand was by far the most potent object for producing both smiles and frowning. Smiling occurred in about 60% of the trials, and almost half of these were rated (1) on the Affect Scale--i.e., the smiles were of an intensity that otherwise was given only to a human stimulus. Frowning occurred in about 20% of the presentations, and in 10% of the 3-month episodes (but rarely by 4 months) the infant repeatedly turned away as the ball reached the near end of its trajectory (these occasional aversive responses showed no relation to reactions to the opening parasol, nor to wariness of the stranger). The broad smiles that often appeared as the object swung near might be interpreted as expressing the infant's delight as he gained a sense of control, through a process of anticipation and repeated confirmation, over the periodic recurrence of a mildly exciting event. Clearly, however, this is but a tentative hypothesis to account for this rather curious effect.

Observations at Six and One-Half Months

Reactions to the wand will be noted briefly, the interest lying only in the contrast with earlier responses. Infants no longer gave broad smiles at its near approach, although about 20% of the trials produced slight smiles as they visually tracked the object. About half of the time infants repeatedly reached for the ball as it came near. On many of the trials, however, infants only attended briefly when the ball entered their visual field.

The rather large beeping object that was first introduced during the 6-1/2-month observations produced few signs of either pleasure or distress. As coded on the Affect Scale, 80% of the trials were rated "neutral"; in 9% the infant smiled at the object (but never broadly), 4% of the trials produced frowning, and in 7% an infant began to cry; rater agreements averaged $\underline{r}$=.86 (24). In comparison with wariness shown to the stranger at this age, crying or frowning in response to the object was not only infrequent but highly inconsistent: only once did the same infant show signs of wariness toward the object in an episode within both of the 2 visits. In light of this inconsistency it is difficult to make firm statements about the capacity of the object to elicit wariness at this age; at most, the reaction was infrequent. Comparisons of the reactions of individual infants to the object and to the stranger also lead to equivocal findings: 5 out of the 6 infants who on occasion frowned or cried at the object were among the top half in wariness toward the stranger--but other infants equally wary of the stranger remained neutral or even smiled toward the object.

Infants reached out and grabbed the object in about 60% of the trials, 2/3 of the time after a delay of less than 10 seconds. Reaching behavior was unrelated to ratings on the Affect Scale or to the sex of the infant. Infants who did not quickly reach out usually seemed simply indifferent to the object, remaining engrossed in objects fixed in the tray that supported babies in the infant seat.

Observations at Nine Months

Since reactions to the first and second presentations of the beeping object differed significantly at age 9 months the 2 episodes will be discussed separately. By criteria of the Affect Scale, reactions to the Object I episodes were not striking: 83% were rated as "neutral," and another 11% as "smiled." No babies crawled away or frowned at the object; crying occurred in 6% of the episodes. In comparison to reactions to the stranger, wariness shown toward the object was again highly infrequent and inconsistent. In no case did the same baby cry at the object in the initial trials of both 9-month bisits, nor was there any overlap with the babies who had cried at the object at 6-1/2 months. Indeed, from these

data alone it remains uncertain as to whether the object could be considered an effective cause of uneasiness.

In half of the Object I episodes the infants crawled up to the object after delays ranging from 3 to 60 seconds and began to pull at its paper "fur." During the delay interval, or for the entire period in instances when no approach was made, attention was distributed between looking at the object (sometimes long and intently, sometimes with only occasional glances), investigating the toy dog, and glancing at or exchanging smiles with mother. It was not possible to infer that infants whose attention was directed elsewhere were actively avoiding looking toward the object: when not so oriented the infant usually remained actively engaged elsewhere and appeared simply indifferent to the object's presence.

The only behavior which was sufficiently frequent to perhaps indicate some degree of wariness was a hesitation before touching the object. In about 1/4 of the episodes (i.e., in half of the approaches), after starting toward the object the infant would hesitate, either with hands on the floor in crawling position or, if closer, with one hand poised in the air preparatory to reaching out, and look intently at the object for periods that ranged from 5 to 25 seconds before completing the approach and touching the object (sometimes contact was never made, the infant either returning to the dog, or being interrupted by termination of the episode). Once having touched the object, however, an infant remained in exploratory contact until the stranger appeared in view (25).

The behavior was significantly different in episodes that followed an encounter with the stranger. Fewer of the trials were rated as "neutral" on the Affect Scale (73%), and in only 2% was a smile directed toward the object. In 18% of the episodes the infant crawled to mother, and in 7% he cried. In 13 out of the 41 available Object I vs. Object II comparisons the infant appeared less easy in the second episode, and no babies changed in the opposite direction (per ratings on the Affect Scale; t tests significant at $p < .02$ for the first visit, and $p < .01$ for the second visit; n's of 19 and 22). Examination of approach behavior in the 13 instances of increased wariness will illustrate the quality of the changes: in 5 instances infants who had ignored the object on the first trial, on second presentations looked at the object and then either crawled to mother or cried; in 3 instances infants who had initially approached after considerable delay (an average of 50 seconds) crawled to their mother in the second trials; in 2 cases infants who had initially approached quickly (in an average of 17 seconds) again approached in the second trials, but after slightly greater delays. In the remaining 3 instances motor behavior was the same on both trials, but the infants no longer smiled at the object.

The n's used in the above comparisons are considerably reduced due to precautions taken in the selection of scorable episodes. It was recognized that infants who had been upset by the stranger

in the preceding episode might continue to seek proximity to the mother even after the stranger had gone, and therefore it was necessary to eliminate Object II episodes in which crawling back to the mother was not due to the presence of the object. Only those Object II episodes in which the infant became engaged in play with the dog or in visual examination of the object after the stranger had left were included; in these episodes any subsequent crawling to the mother or crying occurred after an average of 20 seconds. It is assumed that having been engaged and apart from mother for some time after the stranger departed any distress that subsequently appeared was due to the beeping object. Despite this selection of episodes, however, the factors promoting the evident increase in wariness in second Object episodes remain uncertain: it is not possible to determine whether behavioral change was due to a residual uneasiness which inhibited exploratory interest, or whether the object itself had acquired new attributes from having been presented by a disturbing stranger.

Interview material reinforces the impression that new objects were a less potent source of wariness than unfamiliar persons: although in the 9-month interviews 60% of the mothers reported recent instances of crying at strangers, when asked for instances of crying provoked by objects the only items listed had made loud or sudden noises--e.g., vacuum cleaners, lawn mowers, baby seated on an opening cash-register, etc. On the other hand, since only a small fraction of the population of unfamiliar objects has been sampled it would be hazardous to conclude that strange objects will <u>never</u> induce strong consistent wariness reactions in young infants. In particular, Meili and his staff in Bern have reported aversive reactions during the third and fourth months to a small black ball that was slowly moved toward young infants (a response that reportedly peaked at age 14 weeks, see Pulver, 1959a and b), and at age 10 weeks an uneasiness was found toward irregular two-dimensional patterns (Lang, 1966). In discussing these behaviors Meili (1955) stressed the importance of an infant's level of cognitive development in determining the response to a particular new object. Before reaching the level where a particular configuration reintegrates corresponding schemata the object lacks salience, and beyond a given stage the object is easily assimilated and almost immediately falls into the domain of the familiar. At some critical point, however, a particular stimulus pattern can represent an incongruent event, and wariness may result. Just why Meili believes that an incongruent pattern may induce wariness will be examined later--for the moment the important notion is that the object properties that constitute the domain of the incongruent may be closely linked to an infant's level of cognitive development, and hence would be both limited and transitory. To summarize: it is tentatively concluded that unfamiliar objects are unlikely to be a frequent source of wariness at these ages--but the possibility remains that specific kinds of objects may produce wariness for brief periods at particular stages of cognitive development.

DISCUSSION: WHAT PROVOKES WARINESS?

The data strongly suggest that strange persons are more likely to provoke wariness than are unfamiliar objects--but just why do infants begin to be wary of strangers? Although available data cannot resolve the problem, some seemingly plausible and potentially testable explanations can be offered.

For some three decades Hebbs' (1949) notion of incongruence has been invoked as explanation for a variety of "unlearned fears," including aversive reactions to strangers--but with a minimum of direct evidence (see Bronson, 1968b) and with little progress being made toward refining the meaning of incongruence. In its usual definition incongruence refers to a mismatch between an encoded image of the familiar and its currently perceived novel variant--therefore incongruence can be perceived only after the infant has accumulated sufficient experience to have a sharply defined image of the familiar. Many of the findings from the present study are consistent with Hebbs' notion that wariness can be provoked by the perception of incongruence: (a) faces of familiar persons must be among the earliest sharply encoded images, hence stranger persons should be particularly effective in inducing wariness in young infants; (b) the onset of wariness will be paced by the ability to perceptually distinguish a stranger, and in the present study signs of wariness first began to appear, appropriately, during or shortly after the fourth month of life; (c) when they first appear wariness reactions should be uncertain (e.g., inconsistent) and should emerge only after the infant has engaged in a prolonged examination of the stranger's face--both patterns that were found in the present study; (d) as infants become more certain in their discrimination of strangers the incidence of wariness should sharply increase, a change that was noted between the 4- and 6-1/2-month observations. Other bits of evidence also fit well within this explanation of wariness, such as the recurrent anecdotes of an infant's distress when mother appears in novel form (e.g., in a hat--see examples cited by Schaffer, 1971), and Schaffer's recent experimental study of reactions to a novel object (Schaffer et al., in press).

Drawing on Piagetan theory, and with a reference to Freud's notion that motor behavior can act as a discharge for tension, Meili (1955) has offered a somewhat different explanation for uneasiness provoked by an unfamiliar stimulus; his thesis is particularly directed to reactions observed in infants of around 3 to 7 months of age. The emphasis is on an infant's need to respond, rather than simply on a perceived incongruence: when a salient stimulus is of sufficient duration it impels the infant to seek from within his repertoire some sort of adequate motoric response. The initial phase--an immobile staring--reflects the infant's total concentration as he tries to assimilate the new stimulus into his existing perceptual-motor schemata. If he finds

a response solution--e.g., in a joyful smile or, in the case of objects, in directed reaching--the tension induced by intense concentration subsides. But when the infant is unable to assimilate the stimulus (and hence no response is available to him), and if the input persists with a sufficient degree of "insistence," tension mounts as the exposure continues; this heightened tension produces the behavioral manifestations designated here as wariness. Meili's analysis was based upon observations similar to the findings of the present study, so it is perhaps not surprising that his theory fits well with the 3- and 4-month observations--i.e., with the frequent long and immobile inspections of the stranger's face which sometimes, but not inevitably, resulted in crying, and with the finding that infants prone to distress from an early age (the highly reactive infants) were less able to tolerate the tension induced by the difficulties in assimilation, and hence usually cried.

A third and more radical explanation for an early wariness of strangers can be offered; it warrants careful consideration because if it should prove correct some of the wariness attributed earlier to the perception of incongruent patterns has been misinterpreted. The evidence is convincing that by the third month of life infants begin to take great delight in events that are contingent upon their own acts--indeed, this may be central among the mechanisms that promote the development of smiling (Watson, 1970). It also seems likely that once such expectancies are established an infant can be upset if his socially directed acts fail to produce the expected reactions [cf. references given in Note (2)]. In addition to the above effects, it is possible that as infants begin to establish domains of predictability they may be made wary by a series of salient randomly sequenced events that seem unrelated to their own directed activities (26). If so, the delayed appearance of crying at ages 3 and 4 months, interpreted earlier as due to the gradual awareness of an incongruent face, might have been enhanced by the stranger's persistent, random, but non-contingent behavior. Perhaps to an even greater extent at the older ages the stranger's repeated commands for attention could have deprived infants of a sense that events were under their control--unless at age 9 months an infant maintained authority by crawling away; and being picked up could have been the final insult to an infant's sense of effectance. Infants who smiled, however (and recall that if they did they began almost immediately), achieved an appropriate response, and once engaged in this interplay the stranger and infant were briefly joined in a mutually contingent interaction in which signs of wariness were absent. (Viewed in this light, objects would be relatively benign because they are inanimate: any movements are consistent and hence predictable, proximity can be paced by the infant, and they generally react in a consistent manner to his exploratory manipulations. Schaffer, 1966, makes a similar point.) In summary, it is possible that wariness depends not only--or perhaps as infants grow older,

even minimally--on a perceived unfamiliarity per se, but on whether or not an infant finds the stranger's (or object's) behavior to be predictable—i.e., constant, cyclical, or contingent upon his own directed acts.

REVIEW AND CONCLUSIONS

The emotional tone of reactions given to unfamiliar objects showed no clear pattern of developmental change, and hence these data need only brief review. The dominant orientation, at all ages, was one of exploratory interest; only at the older ages were there some occasional rather equivocal signs of wariness. Whether these represented the beginning of a growing wariness toward novel aspects of the non-social environment, or were transitory, and perhaps specific to a particular kind of object, remains unclear. In contract, a wariness of strange persons began to appear within the fourth month of life, and became increasingly frequent as the infants grew older. Although at times open to alternative interpretations, the responses to the stranger formed a sufficiently coherent pattern to support a tentative theory on the early development of social relations.

It is generally agreed that the earliest social responses are not reserved for specific persons: having only limited powers of perceptual discrimination 2- to 3-month-old infants smile happily at all who approach. The infant subjects seemed to be approaching the end of this period as the study began: at ages 3 and 4 months the stranger was most often greeted with immediate and repeated smiles, but sometimes the infants engaged in protracted immobile staring, and occasionally a prolonged inspection would lead to crying. Although not conclusive, the evidence suggests that whether an infant smiled or cried at these early ages was partly dependent on the clarity with which the stranger could be identified. By age 4 months a few of the infants consistently cried at the stranger's hovering face. These infants seemed temperamentally different from the remaining babies: from an early age they had been particularly prone to distress, and because of this high "reactivity" they seemed less able to tolerate the tensions provoked by their evident ability to distinguish the stranger.

By the next assessments at 6-1/2 months it appeared unlikely that any infants were unaware of the stranger's identity, and about half of the sample consistently appeared in some degree wary in his presence. Reactions were now strongly affected by the nature of an encounter situation: when in mothers' arms smiling predominated and crying was rare; when apart from the mother, however, and particularly when picked up, infants now often cried at the stranger. This situation-linked variability in response indicates that the infants remained open to an affiliative engagement with

a stranger, but only if the circumstances did not arouse an overriding wariness. In addition to situational variables, and to the continued but less predominant effects of differences in temperament, the quality of maternal care had now emerged as a response determinant for the male infants: if the mother was more sensitive and attentive her baby was less prone to wariness; the relation did not hold, however, among female infants. This curious sex difference has been reported in previous samples, and its explanation remains elusive.

At age 9 months the general pattern of reactions was similar to that observed at 6-1/2 months. Parameters of the encounter situation continued to be major response determinants, and infant temperament remained an effective factor, but less so than in the 4-month observations.

The continuity of individual levels of wariness from ages 6-1/2 to 9 months was considerably lower than the limits imposed by measurement reliabilities, indicating that developmental processes were differentially affecting the behaviors of different infants. Although the supporting evidence was indirect, it was suggested that part of the discontinuity was due to the growing effects of previous encounters with new persons. If this was so, then reactions were not necessarily being given to an "incongruent" stimulus, but depended in part on perceived <u>similarities</u> between the stranger and persons previously encountered. Presumably, an infant's experience could promote either pleasant or unpleasant expectancies that would be extended to future encounters. In instances in which the perception of a new person reintegrates unhappy associations an infant may be properly described as fearful, rather than wary: such reactions are based on perceived similarities with an encoded image, rather than on a simple discrepancy between stimulus and schema. Although such acquired aversions are within the learning capacities of younger infants, the available evidence indicated that only toward the end of the first year did reactions begin to be significantly affected by the outcomes of previous stranger encounters.

Expressed in the most general terms, reactions to the larger social environment seem to evolve through an interplay between two developing adaptive systems. On the one hand, infants soon begin to extend affiliative responses to another human being, and to anticipate an appropriate response in return; such reactions are presumably rooted in a developing attachment to familiar caretakers (cf. Ainsworth, in press, and Bowlby, 1969). An opposing tendency is found in the wariness--and in some older infants perhaps a fear--of unfamiliar persons. The development of this (presumably at one time adaptive) system has been traced from its presumed origins in the distress reactions of early infancy, to the emergence of wariness, to the possible development of a more enduring fearfulness. Viewed from this perspective, variables

determining the outcome of a social encounter--be they aspects of the immediate situation, or qualities that reside within the infant--do so through the enhancement or attenuation of one or the other of these opposing systems.

Finally, it should be noted that the transition from a period in which strangers are simply perceived as discrepant, to one in which learned expectations significantly affect an infant's response, may constitute a sensitive period for the development of social competence. Although fearfulness may have roots in an earlier wariness, to be fearful, in contrast to being wary, is to have associated an internal image with unhappy expectations; such structures could be relatively enduring, whereas the basis of wariness will wane with experience. Whether acquired expectations are happy or tinged with fear, they will eventually be reinforced by the responses that they elicit in return.

NOTES

(1) Recording was done with a half-inch battery-powered Sony Videocorder equipped with a 12.5 mm. lens for the 3-, 4- and 6-1/2-month visits, and a 9 mm. lens at age 9 months. No special lighting was necessary with the use of f 1.4 lenses.

(2) If a baby began to cry or, at older ages, crawled to mother, it was evident that the episode should be curtailed. Repeated and unreserved smiling posed a more difficult problem: were the stranger to remain he could either continue to reinforce the behavior with contingent responses for the full minute, or he could respond in a standard fashion, smiling and vocalizing at predetermined intervals regardless of the infant's social signals. Either of these treatments, however, seemed likely to affect reactions to the stranger in subsequent trials since contingent reinforcement increases social responses (Brackbill, 1958; Rheingold, Gewirtz and Ross, 1959; Watson and Ramey, in press), whereas failure to respond to an established social response can promote decreased responsiveness and distress (Ambrose, 1961; Rheingold, Gewirtz and Ross, 1959; Ramey, Heiger and Klisz, 1971; Watson, 1970). Therefore, to minimize learning effects it was decided that the stranger withdraw whenever a smiling pattern was clearly established.

(3) At this age, as well as the one following, the Pick-up episodes were not imposed on babies who cried in a second stranger episode. To avoid a systematic bias in computing the incidence of crying on pick-up it will be assumed that if a baby had cried in the mere presence of the stranger he would also have cried had he been picked up and held.

(4) In the 4-month visits it was possible for both observers to watch the infants' reactions, but at older ages the male stranger had to remain out of the room to avoid pre-exposure to the infant; hence no reliability estimates are available for the latter 2 ages.

(5) There was no evidence that either the initial encounters with the stranger nor the interposed object-episodes systematically affected infants' reactions in the Stranger II episodes: the 8 matched-sample t tests comparing Affect Scale ratings of the Stranger I with Stranger II episodes (2 tests at each of the 4 ages) averaged t=1.35, and none were significant (correlations between Stranger I and Stranger II reactions are given in Table 3). There was also no indication of carry-over effects from the object episodes that preceded the first stranger encounters at older ages. In the few instances when an infant was perhaps upset by the object (cf. reactions to objects, below) the behavior never occurred in both visits, and it was found that infants' reactions in the following stranger episodes did not co-vary with the changing reactions given to the object.

(6) At these early ages crying was by far the most frequent basis for inferring wariness, and since infants are known to cry for a variety of reasons it must be established that the crying observed was indeed a reaction to the stranger's presence. A number of arguments support this contention: (a) In the coded episodes infants had not cried at their mothers during the initial "A" episodes. (b) Crying was not simply due to the mothers' leaving at the end of Episode A: first, it only appeared after a considerable delay (during this interval the infants stared almost continually at the stranger's face, see below); second, crying was equally frequent in the first and second Stranger episodes within a visit. (c) Infants did not cry when the mobile, bracelets or wand replaced the face of the stranger. (d) If an infant cried in one Stranger episode, 60% of the time he cried in both of the Stranger episodes of the same visit. Taken together, these points make it extremely unlikely that the crying observed in the 3- and 4-month Stranger episodes was unrelated to the stranger's presence.

(7) Note that reactions when held by mother were to a female stranger, suggesting a possible alternative explanation for the age-linked change in reactions: perhaps as the infants grew older they became, as a group, relatively more wary of a strange male than of a strange female. Although such an effect may have been operating (cf. Morgan and Ricciutti, 1968), it seems inadequate to explain the opposing age-trends found under the two different conditions.

(8) It is not implied that wariness is an inevitable response to the discrimination of a stranger; at issue is whether some additional process must be posited as a pacer of the onset of wariness.

(9) Reactions when held by mother at 6-1/2 and 9 months have been omitted because signs of wariness were too infrequent to make a significant contribution to these analyses. The remaining encounter situations were given equal weight in computing the composite index. Data from alternate trials were pro-rated to compensate for missing data.

(10) Greater than chance continuities have also been found over this age period by Bronson, 1969a, and Pulver, 1959b (the former study found sex differences in the degree of over-time continuity, but not within the age range of the present research).

(11) Rheingold (1961) has reported that a sample of 3- to 4-month-old institution-reared infants showed less wariness toward a stranger than did comparable home-reared babies, and suggested that exposure to a variety of caretakers may have impeded the development in institution infants of the ability to sharply distinguish a new person. To pursue this notion, the infants of the present sample were classified in terms of the number of adults who routinely tended them: 37% were cared for by 4 or more adults, while the remainder were from homes in which the parents were the only caretakers. The infants who had been eliminated in re-computing developmental continuities were not picked out by this measure. However, by a somewhat different analysis the number of caretakers did make a difference: of the 11 infants who changed most markedly between 4 and 6-1/2 months (Composite Affect Scale scores going from below 3 to greater than 3), the majority, 64%, came from homes with numerous adult caretakers (chi square significant at $p=.06$, total $n=30$). The finding gives indirect support to the notion that 4-month stranger reactions may depend in part on an infant's ability to clearly distinguish a stranger, and that at this age the routine exposure to a variety of adults may impede the development of sharp discriminations.

(12) Since the reactivity measures all proved to be associated with wariness, assurance should be given that they were not selected post hoc from a large battery of possible measures. Two additional measures were, in fact, omitted, but decisions were based only on their doubtful validity; they are briefly noted below.

(13) Ratings are not confounded with possible variations in the infants' reactions to the presence of stranger: their correlation with Affect Scale ratings of wariness in the initial visit was negligible, $r=.14$.

(14) It became apparent during the interviews that retrospective reports could not provide accurate data on the first 2 items: mothers of firstborns had no clear criteria by which to evaluate the amount of crying; as for the others, the judgment clearly depended upon comparison with the characteristics of their previous

babies. Reported reactions to sharp sounds depended on whether a mother attended to her infant's reactions to such events, and the mothers seemed to vary greatly in this regard. Being of uncertain validity, replies to these questions were omitted from the analyses.

(15) There were large variations in infants' responses from one trial to the next within a single series, an effect that permitted alternative indices for assessing an infant's startle behavior: reactions could be averaged across a series or, on the assumption that those trials in which startles were greatest represented the most accurate assessments, the index could be based on the greatest single startle obtained in a set of three trials; the latter index proved consistently more reliable. One can only speculate on the probable cause of this marked variability. In adults the most efficient processing of a brief visual stimulus depends upon its coincidence with a certain phase of alpha wave activity (Lindsley, 1957), and the intensity of a reaction could be similarly affected; infants, who have a relatively low frequency of alpha activity, would be particularly prone to such effects. It is also possible that the exact location of the expanding contour on the infant's retina may have varied from one trial to the next, a variation which could also affect reactions (see Ball and Tronick, 1971).

(16) Ball and Tronick (1971) found that skeletal reactions to a looming stimulus were present beginning at least by 2 weeks of age and showed little change through the second month; initially, however, they were not accompanied by blink responses (personal communication). In contrast, Jones (1926) and White (1969) have reported that blinking at an approaching object usually becomes frequent only by around the third month, and Greenberg, Uzgiris, and Hunt (1968) found that the response was enhanced if infants had been exposed to mobiles hung over their cribs for several weeks.

(17) The strong 4-month relationships for the startle measure were not artifacts due to a possible intensification of startles in babies who had been upset in a preceding Stranger episode. The relationships still hold when 3-month startle reactions, based only on data from visits in which no wariness was shown toward the stranger, are correlated with the 4-month stranger reactions: among Caucasian infants $r=.72$ ($n=13$), and for the total sample $r=.39$ ($n=28$).

(18) Because the stranger was clearly in view as he opened the parasol in the later assessments, certain obviously interesting comparisons could not be made--e.g., contemporaneous correlations between reactions to the stranger and to a looming stimulus. This difficulty, however, does not extend to the foregoing analysis.

(19) The second set of ratings was designed to assure that maternal behaviors which formed the basis for the 3-month judgments

were neither atypical nor limited to the early age period. They were made by the experimenter's assistant (just prior to her leaving the program) on the basis of her accumulated observations in the intervals when mother and infant awaited deployment of the experimental equipment.

(20) I am grateful to Dr. Ainsworth for sharing with me some of her as yet unpublished materials.

(21) A further sex difference emerged in correlations between maternal care and the amount of smiling toward mother at each age (per ratings made in the intervals before beginning the experimental routines): age ages 3, 4, 6-1/2 and 9 months, respectively, the correlations for male infants were $\underline{r}$=.51, $\underline{r}$=.62, $\underline{r}$=.80, and $\underline{r}$=.63--all significant for n's of 14 or 15; for females, however, they were $\underline{r}$=.20, $\underline{r}$=-.09, $\underline{r}$=-.02, and $\underline{r}$=.00--none significant for n's of 15. There were no significant sex differences in the amount of smiling at any of the 4 ages. As was the case with wariness, the male infants again seemed responsive in the expected direction to the quality of maternal care, but comparable effects failed to appear in the female sample.

(22) Crying in a Stranger episode was rare by this age, and it seems likely that these few infants had reacted strongly because of particular associations to specific visual attributes of the stranger. If such effects were operative, then the use of a single stranger must have severely limited the generality of the Composite Affect Scale scores obtained in the 9-month assessments. The relatively poor prediction of 9-month behavior from 6-1/2-month reactions (cf. Table 4) may in part be due to this procedural limitation.

(23) Although infants cried in some 5% of the object episodes at these ages, in all cases the raters rejected the episode as "not scorable" because the response seemed not to be due to the current stimulus, see section on missing data.

(24) Eleven percent of the 6-1/2-month episodes were either not attempted or were rated as "not scorable" because crying continued after the first encounter with the stranger; however, reactions in the Object I episodes that preceded exposure to the stranger were only trivially different from the total values being presented.

(25) Hesitancy before reaching for a novel object has also been reported by Schaffer, Greenwood, and Parry (in press), beginning, correspondingly, at age 9 months. Schaffer, however, offers a different explanation for the 9-month appearance of the behavior; see also Schaffer, 1971.

(26) Charlesworth (1969) in reviewing the literature on "surprise" concluded that a single unexpected event promotes attention; and, at the other extreme, Lewis and Goldberg (1969) have argued that an environment characterized by recurrentnon-contingent events can produce in the infant a chronic sense of "helplessness." The present thesis falls between these positions in suggesting that a brief series of unpredicted events will induce a temporary state of wariness. I am indebted to Dr. Louis Sander for calling my attention to this possibility.

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